Communication of Heat Exchanger Process through Modbus TCP/IP Protocol through MATLAB

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Outline

About Plant

Communication

MODBUS

MATLAB Code and Results

Tools Used
Abstract

**Title:** Communication of Heat Exchanger Process through Modbus TCP/IP protocol through MATLAB for data analysis and control purpose

- A heat exchanger process is connected to the PLC and PLC has a Modbus Ethernet port.
- A Modbus TCP/IP protocol is communicated successfully through MATLAB product Instrument Control Toolbox.
- After this communication, we are able to do data analysis of process and setup for the research experiment purpose.
Boiler and Heat Exchanger Plant Specifications

- Type of Heat Exchanger: Pipe in pipe counter current type
- Boiler Heat Capacity: 30 Kg/hour
- Boiler Operating Range: 3.5 bar and 147°C
- Boiler Type: Electrical Heater (18KW)
- PLC Used: Mircologix 1400 (Allen Bradly)
Boiler and Heat Exchanger Plant

Figure: Boiler and Heat Exchanger Pilot plant
Control Room

Figure: Control Room for Boiler and Heat Exchanger Plant
Figure: Mimic Diagram of Boiler and Heat Exchanger Plant
MODBUS

- MODBUS is an application-layer messaging protocol, positioned at level 7 of the OSI model.
- It can be implemented in the following ways:
  1. MODBUS RTU (Remote Terminal Unit)
  2. MODBUS TCP/IP
- MODBUS TCP/IP protocol can be connected through many points compared to where in RTU protocol can be connected to only one point.
Communication with Plant

- Boiler and hear exchanger plant are connected through PLC to MATLAB software through TCP/IP Modbus protocol.
- Modbus protocol has mainly two different kinds of approaches namely serially connection and Ethernet connection.
- In our experimental set up, plant is connected through Modbus TCP/IP protocol.
- Initially, we faced some problem in serial Modbus.
- Advantage of TCP/IP Modbus protocol over serial Modbus protocol is that connection of hardware can be made from any computer which is in the same network.
Topology of Communication

MATLAB/VLAB/VDCS

Modbus RTU
Serial Port

Modbus TCP/IP
Ethernet Port

Boiler and Heat Exchanger Plant

Figure: Topology of Communication
Message Structure Modbus

- **Transaction Identifier**: 2 bytes set by client
- **Protocol Identifier**: 2 bytes set by client (always 00 00)
- **Length**: 2 bytes, number of bytes in the message to follow (Depending upon Reading and writing operation)
- **Unit Identifier**: 1 byte (Slave ID)
- **FCode**: Function code (1 byte) for MODBUS operation e.g. read analog register (03)
MATLAB Code

- Function for reading data: `gen_pdu_read_TCP.m`
- Fetch process data from received data
- Function for writing data `gen_pdu_write_TCP.m`
Data Drop in MATLAB

Plot for Boiler Temperature

Figure: Data Dropout in MATLAB
Boiler and Heat Exchanger Data

Plot for Boiler Temperature (°C)

Plot for Boiler Level

Figure: Boiler and Heat Exchanger Data

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Boiler and Heat Exchanger Data

Figure: Boiler and Heat Exchanger Data
Graphical User Interface

Figure: GUI for Communication
Problem Faced

- Continuous Data refresh in GUI
- Fetching Data with 0.1 sec sampling time
- Random Data in between (See figure of Data Drop)
Tools used for MODBUS Protocol

- MATLAB
- Instrument Control Toolbox
- MATLAB GUI
THANK YOU
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